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Prize to a Faculty Member for Research in an Undergraduate Institution Recipient: Computational Quantum Field Theory[1]

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I will give an overview on recent attempts to solve the time-dependent Dirac equation for the electron-positron field operator. These numerical solutions permit a first temporally and spatially resolved insight into the mechanisms of how an electron-positron pair can be created from vacuum in a very strong force field. This approach has helped to illuminate a wide range of controversial questions. Some of these questions arise for complicated physical situations such as how an electron scatters off a supercritical potential barrier (Klein paradox). This requires the application of quantum field theory to study the combined effect of the pair-production due to the supercriticality of the potential together with the scattering at the barrier involving the Pauli-principle. Other phenomena include Schrödinger's Zitterbewegung and the localization problem for a relativistic particle. This work has been supported by the NSF and Research Corporation. P. Krekora, K. Cooley, Q. Su and R. Grobe, Phys. Rev. Lett. 95, 070403 (2005). P. Krekora, Q. Su and R. Grobe, Phys. Rev. Lett. 93, 043004 (2004). P. Krekora, Q. Su and R. Grobe, Phys. Rev. Lett. 92, 040406 (2004).

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